Occupational and behavioural factors in the explanation of social inequalities in premature and total mortality: a 12.5-year follow-up in the Lorhandicap study

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Abstract

The respective contribution of occupational and behavioural factors to social disparities in all-cause mortality has been studied very seldom. The objective of this study was to evaluate the role of occupational and behavioural factors in explaining social inequalities in premature and total mortality in the French working population. The study population consisted of a sample of 2189 and 1929 French working men and women, who responded to a self-administered questionnaire in mid-1996, and were followed up until the end of 2008. Mortality was derived from register-based information and linked to the baseline data. Socioeconomic status was measured using occupation. Occupational factors included biomechanical and physical exposures, temporary contract, psychological demands, and social support, and behavioural factors, smoking, alcohol abuse, and body mass index. Significant social differences were observed for premature and total mortality. Occupational factors reduced the hazard ratios of mortality for manual workers compared to managers/professionals by 72% and 41%, from 1.88 (95% CI: 1.17-3.01) to 1.25 (95% CI: 0.74-2.12) for premature mortality, and from 1.71 (95% CI: 1.18-2.47) to 1.42 (95% CI: 0.95-2.13) for total mortality. The biggest contributions were found for biomechanical and physical exposures, and job insecurity. The role of behavioural factors was very low. Occupational factors played a substantial role in explaining social disparities in mortality, especially for premature mortality and men. Improving working conditions amongst the lowest social groups may help to reduce social inequalities in mortality.

Key words: occupational groups, mortality, occupational exposures, health behaviours

Introduction

Social inequalities in health have been reported for a long time. They refer to differences in morbidity and mortality between social groups, i.e. the lower the social position, the poorer the health status, and the measures of morbidity and mortality. These inequalities have been demonstrated for various chronic diseases such as cardiovascular diseases, and general measures of morbidity and mortality [1-4]. Several indicators may be used to measure social position or socioeconomic status (SES), education, occupation, and income being the most widely used of these indicators [5, 6]. Besides the report of social inequalities in health, it appears crucial to better understand the mechanisms linking social position and health. Consequently, identifying mediating factors that may contribute to explain social inequalities in health may be helpful to reduce the exposure to these factors in specific social groups, and thus to reduce social inequalities in health.

Various theories have been developed to explain the pathways and mechanisms underlying these inequalities [7-9]. These theories include the materialist explanation, that put the emphasis on material conditions (access to goods/services, and exposures to material risk factors in the living and working environment), the psychosocial explanation, that focuses on psychosocial and stress related influences with a plethora of risk factors such as social support or sense of control, and the behavioural explanation, that emphasizes the importance of behavioural risk factors in explaining social inequalities in health. As mediating factors probably are interrelated, some authors have suggested simplified causal models to disentangle the direct (independent) effect of mediating factors, and their indirect effect through other factors [10, 11].

Social inequalities in all-cause mortality have been described extensively. Studies showed strong and persistent social inequalities in mortality in various countries, such as France [12], and other European countries [13], but the studies that attempted to explain these inequalities are still sparse. Most of them focused on behavioural factors, such as smoking, alcohol consumption, physical activity, body mass index, etc., and biologic factors (fibrinogen, cholesterol, triglycerides, blood pressure, etc.) as potential mediating factors [14-19]. These studies, in general, found that these factors, and especially smoking, explained a part (that may be small in some studies) of social inequalities in mortality, suggesting that a wider range of factors need to be considered to explain these inequalities.

Occupational factors, that included both material and psychosocial factors, such as physico-chemical, biomechanical, and psychosocial exposures, are considered as major determinants of health, and they may be socially graded (the lower the social position, the higher the exposures). Consequently, they may be pertinent candidates to explain social inequalities in health, as underlined in a recent commentary [20]. Some studies have already mentioned the contribution of occupational factors, especially psychosocial work factors, in explaining at least partly social differences in various measures of morbidity [21-28]. To our knowledge, no previous study has attempted to evaluate the impact of both occupational and behavioural factors on social inequalities in all-cause mortality.

The objectives of this study were to analyse the association between SES as measured using occupation, and two measures of all-cause mortality, premature and total mortality, and to evaluate the contribution of occupational and behavioural factors in explaining social differences in mortality among a sample of men and women of the French working population.

Materials and methods

This study was based on the data from the Lorhandicap survey set up in 1996 in the nord-east of France. Several studies have already been published using this survey [29-31]. The initial sample consisted of everyone aged 15 years or more living in 8000 randomly selected households in the Lorraine region of the north-east of France. Only households with a telephone were eligible. The investigation was approved by the Commission Nationale de l'Informatique et des Libertés (CNIL), and written informed consent was obtained from the respondents. The study protocol included: an application to participate to ascertain the number of persons in the household, and three self-administered questionnaires with a covering letter and a pre-paid envelope for the reply, were mailed at 1-month interval. When the number of individuals was unknown, two questionnaires were sent first, and a complementary one was sent later. The questionnaire included various sections covering socio-demographic characteristics, job characteristics, working conditions, health status, and behavioural factors. If people were retired, they were asked about their main job during working life.

SES was measured using occupational groups. Four occupational categories were considered following the international classification of occupation (ISCO): professionals/managers, associate professionals/technicians, service workers/clerks, and manual workers. Professionals/managers were used as reference category. Occupation was studied as a marker of SES because it characterises adult SES, is available for all working people, and may reflect occupational exposures better than education [5, 6].

Occupational factors were assessed by: biomechanical exposure (exposure to vibrations - manual handling of vibrating tools or vibration from a fixed machine-, manual materials handling, postural and articular constraints such as standing/walking, awkward posture, handling objects or tools, working on a production line, or other constraints), physical exposure (exposure to noise, cold or hot temperatures, or outdoor work), work status (temporary versus permanent job) as a marker of job insecurity, psychological demands (exposure to high work pace, or mental load), and social support from colleagues (very unsatisfied, or unsatisfied versus neither satisfied nor unsatisfied, satisfied, or very satisfied). Exposure to biomechanical and physical factors, and to psychological demands was defined by the presence of at least one item. Details on the formulation of the question and items, as well as the number and percentage of exposed people for each item separately may be found in the appendix. The factors that were the most prevalent were standing/walking, awkward posture, and manual materials handling for biomechanical factors, and noise, and hot and cold temperatures for physical factors. The study of the associations between the 5 occupational exposures studied (biomechanical and physical exposures, work status, psychological demands, and social support) showed three significant positive associations ($p<0.001$) between biomechanical exposure and physical exposure, between biomechanical exposure and psychological demands, and between temporary contract and low social support, as well as two significant negative associations between psychological demands and temporary contract ($p<0.001$) and between psychological demands and low social support ($p<0.01$) i.e. that people with high levels of psychological demands were less likely to have a temporary work contract and low levels of social support.

Behavioural factors included: smoking status (smoker, ex-smoker or non-smoker), body mass index (BMI) in kg/m^2, and alcohol abuse measured using the French version of the Cut/Annoyed/Guilty/Eye-opener (CAGE) questionnaire [32] and defined by at least two positive responses to four items: consumption considered excessive by the subject, consumption considered excessive by people around the subject, subject wishes to reduce consumption, and consumption on waking.

The cohort was followed up for mortality from 1st July 1996 to 31th December 2008. The vital status of all subjects was assessed by searching using the national computerised database listing all deceased subjects in France, contacting the registry offices of the birth places for people born in France, and the registry office devoted to foreign born French people (Ministry of Foreign Affairs). Two measures of mortality were considered: death, and premature death before the age of 70. Premature death focusses on deaths occurring at younger ages, and may be considered as a useful public health measure providing information on preventable deaths. In addition, this outcome was retained because, as reported by Krieger et al. [33], unlike life expectancy and years of personlives lost, it is easy to understand, easy to compare, methodologically transparent, and a sensitive indicator of inequities in health.

The associations between SES (i.e. occupation) and occupational and behavioural factors were tested using the Chi-Square test to determine the significance and direction of these associations. Cox proportional hazard model, which yields hazard ratios (HRs), was used to examine the association between SES and mortality. The duration of follow-up for each subject was calculated for each subject from 1st July 1996 to 31th December 2008, or earlier in the case of death, or 70th birthday for premature mortality. The associations between occupational and behavioural factors and mortality were also examined using Cox regression models. Occupational and behavioural factors that displayed inverse social gradients were excluded in subsequent analyses. Several models were performed: a basic model (model 1) measuring the association between SES and mortality after adjustment for age (and sex), behavioural factors added to model 1 (model 2), occupational factors added to model 1 (model 3), and behavioural and occupational factors added simultaneously to model 1 (model 4). The contribution of behavioural and/or occupational factors to the explanation of the social differences in mortality was estimated by the change in the HRs for occupational groups after inclusion of the variable(s) in the model, i.e. explained fraction calculated by the formula: $(HR_{model\ 1}–HR_{extended\ model})/(HR_{model\ 1}–1)$ [16]. Positive % values indicate reductions in HRs, and negative % values increases in HRs. The contribution was calculated only if the HR for a given occupational group was significant in model 1. The proportional hazard assumption was checked based on Schoenfeld residuals for the global model and for each covariate. Analyses were also done with additional adjustment for chronic disease at baseline, the results were unchanged. Results are presented for men and women separately, and for the total sample for Cox regression models. The statistical analyses were performed using STATA software.

Results

Of the 8000 households included in the sample, mailings to 193 (2%) were lost (due to addressing error or death). Of the 7807 households contacted, 3460 (44.3%) participated (all eligible members of the family took part in 86% of those). In total, 6235 subjects filled in the questionnaire, 19 were of unknown sex or age, leaving 6216 subjects who were similar in age and sex distribution to the overall population of the north-east of France [30]. During the follow-up, 143 subjects (2.3%) were lost and excluded. The subjects with unknown smoking habit or alcohol abuse were excluded (296 subjects, i.e. 4.8%). Only the subjects who had been working, were alive, and aged 70 years or less at baseline (1st July 1996) were retained for this study i.e. 4118 subjects, 2189 men and 1929 women. In total, 291 deaths (206 and 85 among men and women) occurred, and 165 deaths before age 70 (115 and 50 among men and women).

Almost all behavioural and occupational factors displayed strong and significant associations with SES, except alcohol abuse for men and women, and smoking for women (Table 1). A trend towards increasing alcohol abuse with lower SES was observed for men. Biomechanical and physical exposures, temporary contract, and low social support were strongly socially graded, the lower the occupational group, the higher the exposure. High psychological demands displayed a significant inverse social gradient, managers/professionals being more likely to be exposed. Psychological demands were consequently omitted from subsequent analyses.

A significant association was found between SES and premature mortality (Table 2), which was confirmed after adjustment for age and sex (model 1), manual workers being at increased risk of mortality. This association was observed for men and women separately, although non significant for women. Male gender and all behavioural and occupational factors displayed significant crude associations with premature mortality (not all significant for each gender separately). Adding behavioural factors to model 1 did not change the HRs for manual workers very much (model 2). Additional analyses (not shown) exploring the separate effects of each behavioural factor showed that the biggest contribution was found for alcohol abuse (7%) in the total sample. The inclusion of occupational factors to model 1 led to a substantial decrease in the HRs for manual workers, by 72% for the total sample, 74% for men, and 61% for women. The HRs for manual workers were no longer significant after adjustment for occupational factors. The occupational factors that contributed to decrease the social difference in premature mortality were in the total sample (not shown): biomechanical exposure (35%), job insecurity (28%), physical exposure (24%), and social support (14%). Model 4 that included behavioural and occupational factors simultaneously provided a similar explanation of social differences in premature mortality than model 3.

Significant social differences for total mortality were observed (Table 3). Manual workers were at higher risk for mortality, a similar trend was observed for service workers/clerks after adjustment for age and sex (model 1). Social differences were also found for men and women separately, manual workers being at significant higher risk of mortality for men. Male gender and almost all behavioural and occupational factors were found to be predictive factors of mortality in crude associations. The inclusion of behavioural factors to model 1 did not modify the HRs for manual workers very much (model 2). Studying each factor separately showed that the biggest contributions were found for BMI (6%) and alcohol abuse (4%) in the total sample. Adding occupational factors to model 1 contributed to decrease the social differences between manual workers and managers/professionals by 41% for the total sample, 44% for men, and 31% for women (model 3). The HRs for manual workers were no longer significant after adjustment for occupational factors. The contributions of each occupational factor separately were as follows in the total sample: job insecurity (23%), social support (11%), biomechanical exposure (10%), and physical exposure (8%). Adding behavioural and occupational factors simultaneously increased only slightly the explained fractions (model 4) compared to model 3.

Discussion

Significant social differences were observed for premature and total mortality in this 12.5-year follow-up study among the French working population. Manual workers were at increased risk of total and premature mortality compared to managers/professionals with HRs reaching almost 2. Occupational factors played a substantial role in explaining social differences in mortality. Their contributions were 31-74%, and were more pronounced for men and for premature mortality. The contribution of behavioural factors was very low.

Manual workers were the occupational group that displayed a significant excess of mortality compared to managers/professionals. Other previous studies showed social disparities in mortality in France and in other countries, using various SES markers [12, 13]. Our study also underlined social inequalities in occupational exposures, with the lowest occupational groups, especially manual workers, being more likely to be exposed to negative working conditions. Other previous studies reported the accumulation of unfavourable working conditions in the lowest occupational categories [22, 23, 25-27]. One major exception was psychological demands, that displayed a strong inverse social gradient, managers/professionals being more likely to be exposed, something already reported [22, 23, 25, 26].

Although there were a number of studies describing social inequalities in mortality in various populations, studies that tried to explain these inequalities were less numerous. This study is one of the seldom studies evaluating the contribution of occupational factors to social inequalities in all-cause mortality, and suggested that these factors may play a substantial role.

Other studies explored the contribution of occupational factors to social inequalities in several measures of morbidity. Our study is in agreement with some previous studies underlying the role of physical and biomechanical exposure [22, 24-26, 28], job insecurity [21, 23], and low social support [25, 27] in explaining social inequalities in health outcomes such as self-reported health. Furthermore, the occupational factors, that were the most prevalent, may play a substantial role in explaining social differences in mortality, i.e. standing/walking, awkward posture, and manual materials handling among the biomechanical factors, and noise, and hot and cold temperatures among the physical factors, supporting previous results on the explanation of social inequalities in morbidity outcomes in France [25]. Our results are also in agreement with another study showing that the role of occupational factors in explaining social inequalities in health was not modified very much when behavioural factors were taken into account [22]. The issue of independent (direct) and indirect (through behavioural factors) effects of occupational factors is consequently less important in our study as we did not observe any major role of behavioural factors. Consequently, the contribution of occupational factors remained almost the same with or without adjusting for behavioural factors.

Behavioural factors did not play an important role in explaining social inequalities in mortality in our study. Other authors demonstrated that behavioural factors may explain only a modest proportion of social inequalities in mortality [10, 11, 15]. Several hypotheses may be assumed to explain this. Behavioural factors were evaluated only at baseline, and as the follow-up was long, people might change their behaviours, which is likely to lead to misclassification and dilution of their effects. Behavioural factors were based on self-reported data, that may lead to an underreporting bias of the most negative health behaviours. For example, the heaviest drinkers may be underrepresented in our sample, because of both selection and underreporting bias. Evaluation of alcohol consumption was done using the CAGE instrument that may be adequate to measure alcohol-related problems, but may neglect some specific ones that may be more strongly related to SES, such as binge drinking.

Gender differences were also of interest in our study, this was why genders were studied separately. Women were more likely to be service workers/clerks, and men manual workers. The prevalence of occupational and behavioural factors was found to be different between genders. Men were more likely to be exposed to physical exposure, and women to job insecurity. Men were more likely to be smokers and overweight, and to have alcohol-related problems. The risk of mortality was also higher for men than for women. These results confirm the different patterns of occupation and occupational exposures between genders, related to the strong sexual division of labour, as well as the differences in health behaviours and mortality between genders. Similar social inequalities in mortality were observed for men and women, but the contribution of occupational factors was found to be higher in men than in women. This result is in agreement with other studies [25]. Strong gender differences were observed for the associations between behavioural factors and mortality; smoking and alcohol abuse were found to be strong predictors of premature and total mortality for men, but not for women. Nevertheless, the contribution of behavioural factors was very modest and appeared to be similar in explaining social inequalities in mortality in both genders.

Limitations of our study may be mentioned. A selection bias may have occurred, as the response rate was about 44%. However, this response rate is similar to those of other studies using postal self-administered questionnaires in France [34]. Furthermore, the gender and age distributions of the initial sample were close to those of the census population. Nevertheless, previous studies showed that non-respondents may be more likely to have lower SES, poorer health-related and behavioural factors [34]. Consequently, it is likely that such a bias may lead to underestimate social inequalities in health. A limitation was related to sample size especially for women, and led to more uncertainty in the estimation of HRs and explained fractions for this group. Another limitation was that behavioural and occupational factors were not based on lifetime exposures. Other authors demonstrated that this may lead to underestimate the contributions of behavioural and occupational factors to social inequalities in health [35, 36]. The contribution of these factors may also be underestimated because some behavioural and occupational factors were not explored, such as diet or physical activity, as well as chemical/biological exposures, decision latitude at work, reward, or workplace violence. Thus, inclusion of more mediators might result in different estimates of the contributions of mediators. Finally, the generalisation of our results to other populations should be made with caution because of cultural and socioeconomic differences between countries.

Strengths of the study also deserve to be mentioned. The sample was derived from the general population, making generalisation possible for the population in the nord-east of France. Sample size allowed us to study men and women separately, which may be crucial in occupational epidemiology [37]. The study was based on a 12.5-year follow-up, i.e. a rather long period. Mortality was measured using national database (an exhaustive and independent source of data). Mortality is also an objective outcome measure, consequently no reporting bias may be suspected. Occupational groups were used in this study as a marker of social position, and are a well-known measure of social position in the working population. Although results may differ somewhat using other measures of social position (such as education or income) [5, 6], relatively similar conclusions have been provided by others [24, 36]. We performed additional analyses that included the presence of chronic disease at baseline in our models to make sure that no previous chronic disease may introduce a confounding effect in our results. These results confirmed the robustness of our findings. We also performed the analyses for premature mortality before 65 and found similar results, but statistical power was lower because of a smaller number of premature deaths.

To conclude, occupational factors may play a substantial role in explaining social inequalities in mortality, especially premature mortality. Preventive actions focusing on these factors and specific social groups may be useful to reduce social inequalities in mortality. More research is needed to better understand the role of these factors, over the life course, on social inequalities in various health outcomes.

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Appendix. Description and prevalence (No. of exposed, % exposed) of occupational exposures among the population studied (N=4118)

The question was: please indicate the occupational exposures you have (had) been highly exposed during your working life

Exposure	No. of exposed (N)	% exposed
Biomechanical exposures		
Manual handling of vibrating tools	218	5.3
Vibration from a fixed machine	160	3.9
Manual materials handling	550	13.4
Standing and walking	736	17.9
Awkward posture	634	15.4
Handling objects or tools	167	4.1
Working on a production line	204	5.0
Other biomechanical constraints	555	13.5
Physical exposures		
Noise	1178	28.6
Cold temperatures	676	16.4
Hot temperatures	821	19.9
Outdoor work	284	6.9
Psychological demands		
High work pace	725	17.6
Mental load	928	22.5

Table 1 Associations between SES (occupation) and age, behavioural and occupational factors

	Total sample		Managers, professionals		Associate professionals, technicians		Service workers, clerks		Manual workers		P
	N	%	N	%	N	%	N	%	N	%	
MEN	N=2189		N=433	19.8	N=467	21.3	N=448	20.5	N=841	38.4	
Age (y)											***
<40	981	44.8	176	40.7	165	35.3	232	51.8	408	48.5	
40-59	829	37.9	188	43.4	201	43.0	150	33.5	290	34.5	
≥60	379	17.3	69	15.9	101	21.6	66	14.7	143	17.0	
Smoking											***
Non-smoker	582	26.6	130	30.0	126	27.0	118	26.3	208	24.7	
Ex-smoker	864	39.5	180	41.6	201	43.0	189	42.2	294	35.0	
Smoker	743	33.9	123	28.4	140	30.0	141	31.5	339	40.3	
Alcohol abuse	290	13.2	48	11.1	54	11.6	65	14.5	123	14.6	NS
BMI (kg/m²)											***
<25	990	45.2	213	49.2	190	40.7	229	51.1	358	42.6	
25-30	829	37.9	178	41.1	181	38.8	157	35.0	313	37.2	
>30	370	16.9	42	9.7	96	20.6	62	13.8	170	16.9	
Biomechanical exposure	975	44.5	63	14.5	201	43.0	154	34.4	557	66.2	***
Physical exposure	1177	53.8	94	21.7	277	59.3	180	40.2	626	74.4	***
Temporary contract	820	37.5	116	26.8	194	41.5	157	35.0	353	42.0	***
High psychological demands	782	35.7	234	54.0	166	35.5	156	34.8	226	26.9	***
Low social support	721	32.9	122	28.2	140	30.0	145	32.4	314	37.3	**
WOMEN	N=1929		N=278	14.4	N=140	7.3	N=1161	60.2	N=350	18.1	
Age (y)											***
<40	950	49.2	141	50.7	65	46.4	617	53.1	127	36.3	
40-59	690	35.8	111	39.9	49	35.0	409	35.2	121	34.6	
≥60	289	15.0	26	9.4	26	18.6	135	11.6	102	29.1	
Smoking											NS
Non-smoker	949	49.2	140	50.4	64	45.7	555	47.8	190	54.3	
Ex-smoker	483	25.0	76	27.3	31	22.1	294	25.3	82	23.4	
Smoker	497	25.8	62	22.3	45	32.1	312	26.9	78	22.3	
Alcohol abuse	67	3.5	13	4.7	6	4.3	40	3.4	8	2.3	NS
BMI (kg/m²)											***
<25	1259	65.3	218	78.4	99	70.7	762	65.6	180	51.4	
25-30	347	18.0	34	12.2	22	15.7	210	18.1	81	23.1	
>30	323	16.7	26	9.4	19	13.6	189	16.3	89	25.4	
Biomechanical exposure	813	42.2	59	21.2	71	50.7	466	40.1	217	62.0	***
Physical exposure	567	29.4	58	20.9	42	30.0	279	24.0	188	53.7	***
Temporary contract	933	48.4	900	32.4	67	47.9	541	46.6	235	67.1	***
High psychological demands	602	31.2	157	56.5	45	32.1	300	25.8	100	28.6	***
Low social support	697	36.1	70	25.2	52	37.1	397	34.2	178	50.9	***

Chi-Square test to test the association between SES (occupation) and each mediator, *p<0.05, **p<0.01, ***p<0.001

Table 2 Contribution of behavioural and occupational factors to social differences in premature mortality (<70y)

TOTAL SAMPLE N=4118	Crude HR	95% CI	Adjusted HR (1)	95% CI	Adjusted HR (2)	95% CI	%	Adjusted HR (3)	95% CI	%	Adjusted HR (4)	95% CI	%
SES (occupation)													
Managers, professionals	1		1		1			1			1		
Associate professionals, technicians	1.25	0.70-2.22	1.02	0.57-1.82	1.02	0.57-1.82		0.78	0.43-1.43		0.78	0.43-1.45	
Service workers, clerks	0.96	0.59-1.57	1.40	0.84-2.32	1.37	0.82-2.28		1.13	0.67-1.90		1.12	0.66-1.88	
Manual workers	1.92**	1.20-3.08	1.88**	1.17-3.01	1.88**	1.17-3.03	0	1.25	0.74-2.12	72	1.27	0.75-2.17	69
Men	2.08***	1.49-2.90	1.96***	1.38-2.82	1.59*	1.08-2.33		2.08***	1.44-3.00		1.68**	1.13-2.49	
Smoking													
Non-smoker	1				1						1		
Ex-smoker	2.14***	1.46-3.13			1.52*	1.02-2.28					1.49*	1.00-2.23	
Smoker	1.40	0.93-2.12			1.57*	1.01-2.43					1.57*	1.01-2.44	
Alcohol abuse	2.63***	1.80-3.85			2.01***	1.35-2.98					1.90**	1.28-2.83	
BMI (kg/m²)													
<25	1				1						1		
25-30	1.71**	1.22-2.41			0.90	0.63-1.28					0.91	0.63-1.31	
>30	1.58*	1.04-2.39			0.90	0.59-1.38					0.91	0.60-1.40	
Biomechanical exposure	1.52**	1.12-2.06						1.35§	0.96-1.90		1.31	0.93-1.84	
Physical exposure	1.59**	1.17-2.15						1.19	0.83-1.70		1.18	0.82-1.68	
Temporary contract	2.81***	2.05-3.85						1.86***	1.28-2.70		1.80**	1.24-2.63	
Low social support	2.21***	1.62-2.99						1.39*	1.00-1.94		1.39*	1.00-1.93	

*p<0.05, **p<0.01, ***p<0.001, §p<0.10.
(1) Model 1 (adjusted for SES, gender, and age)
(2) Model 2 = Model 1 + smoking, alcohol abuse, and BMI
(3) Model 3 = Model 1 + biomechanical exposure, physical exposure, temporary contract, and social support
(4) Model 4 = Model 1 + Model 2 + Model 3
% = Reduction (positive %) or increase (negative %) in HR computed with the following formula: $(HR_{\text{model 1}} - HR_{\text{extended model}})/(HR_{\text{model 1}} - 1)$

Table 2 (continued)

MEN N=2189	Crude HR	95% CI	Adjusted HR (1)	95% CI	Adjusted HR (2)	95% CI	%	Adjusted HR (3)	95% CI	%	Adjusted HR (4)	95% CI	%
SES (occupation)													
Managers, professionals	1		1		1			1			1		
Associate professionals, technicians	1.13	0.60-2.12	1.03	0.55-1.94	1.03	0.55-1.94		0.78	0.40-1.53		0.78	0.39-1.53	
Service workers, clerks	1.07	0.57-2.02	1.25	0.66-2.37	1.19	0.63-2.25		0.98	0.51-1.89		0.94	0.49-1.82	
Manual workers	1.65§	0.97-2.81	1.89*	1.11-3.21	1.85*	1.08-3.16	4	1.23	0.67-2.27	74	1.21	0.66-2.25	76
Smoking													
Non-smoker	1				1						1		
Ex-smoker	2.77***	1.59-4.81			1.82*	1.03-3.19					1.74*	1.00-3.06	
Smoker	1.98*	1.11-3.53			1.97*	1.10-3.55					1.95*	1.08-3.52	
Alcohol abuse	2.42***	1.60-3.65			2.12***	1.40-3.23					1.98***	1.30-3.02	
BMI (kg/m²)													
<25	1				1						1		
25-30	1.45§	0.97-2.18			0.89	0.59-1.36					0.92	0.60-1.40	
>30	1.41	0.84-2.38			0.84	0.49-1.44					0.86	0.50-1.47	
Biomechanical exposure	1.62**	1.12-2.34						1.38	0.90-2.10		1.34	0.88-2.04	
Physical exposure	1.39§	0.95-2.02						1.09	0.71-1.69		1.11	0.72-1.70	
Temporary contract	4.01***	2.74-5.86						2.33***	1.49-3.64		2.23***	1.42-3.51	
Low social support	2.34***	1.62-3.38						1.39§	0.94-2.05		1.35	0.91-2.00	

*p<0.05, **p<0.01, ***p<0.001, §p<0.10.
(1) Model 1 (adjusted for SES and age)
(2) Model 2 = Model 1 + smoking, alcohol abuse, and BMI
(3) Model 3 = Model 1 + biomechanical exposure, physical exposure, temporary contract, and social support
(4) Model 4 = Model 1 + Model 2 + Model 3
% = Reduction (positive %) or increase (negative %) in HR computed with the following formula: $(HR_{model\ 1} - HR_{extended\ model})/(HR_{model\ 1} - 1)$

Table 2 (continued)

WOMEN N=1929	Crude HR	95% CI	Adjusted HR (1)	95% CI	Adjusted HR (2)	95% CI	%	Adjusted HR (3)	95% CI	%	Adjusted HR (4)	95% CI	%
SES (occupation)													
Managers, professionals	1		1		1			1			1		
Associate professionals, technicians	0.86	0.17-4.44	0.83	0.16-4.27	0.84	0.16-4.35		0.70	0.13-3.64		0.71	0.13-3.70	
Service workers, clerks	1.47	0.57-3.79	1.55	0.60-3.99	1.58	0.61-4.10		1.38	0.53-3.60		1.41	0.54-3.70	
Manual workers	2.41§	0.86-6.75	1.87	0.66-5.29	1.94	0.68-5.54	-8	1.34	0.45-4.03	61	1.41	0.46-4.28	53
Smoking													
Non-smoker	1				1						1		
Ex-smoker	1.18	0.63-2.21			1.31	0.69-2.47					1.30	0.69-2.46	
Smoker	0.61	0.28-1.30			1.10	0.50-2.41					1.10	0.50-2.43	
Alcohol abuse	1.11	0.27-4.56			1.16	0.28-4.84					1.18	0.28-4.93	
BMI (kg/m²)													
<25	1				1						1		
25-30	1.39	0.68-2.86			0.85	0.41-1.78					0.86	0.41-1.80	
>30	1.64	0.82-3.29			1.00	0.49-2.04					0.99	0.49-2.02	
Biomechanical exposure	1.25	0.72-2.19						1.30	0.72-2.35		1.28	0.70-2.32	
Physical exposure	1.31	0.74-2.33						1.37	0.74-2.56		1.34	0.72-2.51	
Temporary contract	1.84*	1.04-3.22						1.12	0.57-2.20		1.11	0.56-2.20	
Low social support	2.11**	1.21-3.68						1.50	0.81-2.79		1.53	0.82-2.85	

*p<0.05, **p<0.01, ***p<0.001, §p<0.10.
(1) Model 1 (adjusted for SES and age)
(2) Model 2 = Model 1 + smoking, alcohol abuse, and BMI
(3) Model 3 = Model 1 + biomechanical exposure, physical exposure, temporary contract, and social support
(4) Model 4 = Model 1 + Model 2 + Model 3
% = Reduction (positive %) or increase (negative %) in HR computed with the following formula: $(HR_{model\ 1} – HR_{extended\ model})/(HR_{model\ 1} – 1)$

Table 3 Contribution of behavioural and occupational factors to social differences in total mortality

TOTAL SAMPLE N=4118	Crude HR	95% CI	Adjusted HR (1)	95% CI	Adjusted HR (2)	95% CI	%	Adjusted HR (3)	95% CI	%	Adjusted HR (4)	95% CI	%
SES (occupation)													
Managers, professionals	1		1		1			1			1		
Associate professionals, technicians	1.73**	1.14-2.63	1.27	0.83-1.93	1.25	0.82-1.90		1.13	0.73-1.75		1.11	0.72-1.72	
Service workers, clerks	0.98	0.66-1.44	1.40§	0.94-2.08	1.38	0.93-2.06		1.26	0.84-1.88		1.24	0.82-1.86	
Manual workers	1.96***	1.35-2.83	1.71**	1.18-2.47	1.71**	1.18-2.49	0	1.42§	0.95-2.13	41	1.41§	0.94-2.13	42
Men	2.19***	1.70-2.82	2.10***	1.60-2.76	1.78***	1.32-2.39		2.19***	1.66-2.90		1.83***	1.35-2.49	
Smoking													
Non-smoker	1				1						1		
Ex-smoker	2.06***	1.56-2.71			1.41*	1.04-1.90					1.40*	1.04-1.90	
Smoker	1.15	0.83-1.58			1.60**	1.13-2.25					1.62**	1.15-2.29	
Alcohol abuse	2.00***	1.45-2.74			1.71**	1.23-2.37					1.68**	1.21-2.34	
BMI (kg/m²)													
<25	1				1						1		
25-30	1.74***	1.33-2.28			0.83	0.63-1.09					0.84	0.64-1.11	
>30	2.19***	1.64-2.93			1.09	0.81-1.47					1.10	0.81-1.49	
Biomechanical exposure	1.14	0.91-1.44						1.08	0.84-1.40		1.06	0.82-1.37	
Physical exposure	1.32*	1.05-1.66						1.06	0.81-1.39		1.08	0.83-1.41	
Temporary contract	4.67***	3.56-6.13						1.86***	1.30-2.64		1.82***	1.28-2.59	
Low social support	2.63***	2.08-3.31						1.28*	1.00-1.65		1.28*	1.00-1.65	

*p<0.05, **p<0.01, ***p<0.001, §p<0.10.

(1) Model 1 (adjusted for SES, gender, and age)

(2) Model 2 = Model 1 + smoking, alcohol abuse, and BMI

(3) Model 3 = Model 1 + biomechanical exposure, physical exposure, temporary contract, and social support

(4) Model 4 = Model 1 + Model 2 + Model 3

% = Reduction (positive %) or increase (negative %) in HR computed with the following formula: $(HR_{\text{model 1}} - HR_{\text{extended model}})/(HR_{\text{model 1}} - 1)$

Table 3 (continued)

MEN N=2189	Crude HR	95% CI	Adjusted HR (1)	95% CI	Adjusted HR (2)	95% CI	%	Adjusted HR (3)	95% CI	%	Adjusted HR (4)	95% CI	%
SES (occupation)													
Managers, professionals	1		1		1			1			1		
Associate professionals, technicians	1.34	0.85-2.11	1.11	0.71-1.74	1.08	0.69-1.71		0.99	0.62-1.60		0.95	0.59-1.54	
Service workers, clerks	1.06	0.65-1.71	1.19	0.74-1.92	1.16	0.72-1.88		1.07	0.66-1.74		1.03	0.63-1.68	
Manual workers	1.53*	1.02-2.29	1.61*	1.07-2.40	1.60*	1.06-2.40	2	1.34	0.86-2.10	44	1.31	0.83-2.06	49
Smoking													
Non-smoker	1				1						1		
Ex-smoker	2.85***	1.90-4.28			1.70**	1.12-2.56					1.66*	1.10-2.51	
Smoker	1.65*	1.06-2.57			1.93**	1.23-3.03					1.94**	1.24-3.05	
Alcohol abuse	1.79***	1.28-2.51			1.85***	1.31-2.60					1.81***	1.29-2.56	
BMI (kg/m²)													
<25	1				1						1		
25-30	1.34§	0.98-1.84			0.76	0.55-1.06					0.78	0.56-1.08	
>30	1.96***	1.37-2.80			1.01	0.70-1.46					1.03	0.71-1.49	
Biomechanical exposure	1.12	0.85-1.48						1.04	0.76-1.41		1.02	0.75-1.39	
Physical exposure	1.14	0.87-1.51						1.05	0.76-1.43		1.07	0.78-1.47	
Temporary contract	6.36***	4.58-8.83						2.26***	1.48-3.47		2.19***	1.43-3.37	
Low social support	2.71***	2.06-3.57						1.25	0.93-1.68		1.23	0.91-1.66	

*p<0.05, **p<0.01, ***p<0.001, §p<0.10.
(1) Model 1 (adjusted for SES and age)
(2) Model 2 = Model 1 + smoking, alcohol abuse, and BMI
(3) Model 3 = Model 1 + biomechanical exposure, physical exposure, temporary contract, and social support
(4) Model 4 = Model 1 + Model 2 + Model 3
% = Reduction (positive %) or increase (negative %) in HR computed with the following formula: $(HR_{\text{model 1}} – HR_{\text{extended model}})/(HR_{\text{model 1}} – 1)$

Table 3 (continued)

WOMEN N=1929	Crude HR	95% CI	Adjusted HR (1)	95% CI	Adjusted HR (2)	95% CI	%	Adjusted HR (3)	95% CI	%	Adjusted HR (4)	95% CI	%
SES (occupation)													
Managers, professionals	1		1		1			1			1		
Associate professionals, technicians	3.24*	1.06-9.91	2.63§	0.86-8.06	2.57§	0.84-7.92		2.35	0.76-7.29		2.30	0.74-7.17	
Service workers, clerks	2.27§	0.90-5.71	2.24§	0.89-5.64	2.19§	0.87-5.55		2.05	0.81-5.19		1.99	0.78-5.09	
Manual workers	4.09**	1.57-10.68	2.48§	0.94-6.52	2.41§	0.90-6.42	5	2.02	0.74-5.52	31	1.96	0.71-5.43	35
Smoking													
Non-smoker	1				1						1		
Ex-smoker	0.86	0.52-1.42			1.12	0.67-1.86					1.15	0.68-1.91	
Smoker	0.49*	0.27-0.90			1.21	0.54-2.31					1.24	0.65-2.36	
Alcohol abuse	0.67	0.16-2.70			0.80	0.20-3.28					0.79	0.19-3.26	
BMI (kg/m²)													
<25	1				1						1		
25-30	1.89*	1.12-3.19			1.04	0.61-1.78					1.05	0.61-1.80	
>30	2.23**	1.34-3.71			1.21	0.72-2.05					1.21	0.71-2.05	
Biomechanical exposure	1.12	0.73-1.71						1.17	0.74-1.85		1.17	0.74-1.86	
Physical exposure	1.00	0.63-1.60						1.13	0.69-1.87		1.14	0.69-1.88	
Temporary contract	3.13***	1.93-5.09						1.17	0.63-2.18		1.17	0.63-2.19	
Low social support	2.72***	1.76-4.20						1.40	0.86-2.29		1.41	0.86-2.30	

*p<0.05, **p<0.01, ***p<0.001, §p<0.10.
(1) Model 1 (adjusted for SES and age)
(2) Model 2 = Model 1 + smoking, alcohol abuse, and BMI
(3) Model 3 = Model 1 + biomechanical exposure, physical exposure, temporary contract, and social support
(4) Model 4 = Model 1 + Model 2 + Model 3
% = Reduction (positive %) or increase (negative %) in HR computed with the following formula: $(HR_{\text{model 1}} - HR_{\text{extended model}})/(HR_{\text{model 1}} - 1)$